ED 319 405 IR 053 155

TITLE Information Sources on Scientific Research Related to the Preservation of Books, Paper, and Adhesives. Directory.
INSTITUTION Commission on Preservation and Access, Washington, DC.
PUB DATE Mar 90
NOTE 31p.
PUB TYPE Reference Materials - Directories/Catalogs (132) -- Reports - Descriptive (141)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Adhesives; *Archives; *Library Materials; *Library Technical Processes; Paper (Material)
IDENTIFIERS Book Preservation; *Deterioration (Books); *Library Materials Conservation; Library of Congress; Mold

ABSTRACT

Produced as part of an effort by the Commission on Preservation and Access to assist with the formation of a preservation research agenda, this report contains: (1) a directory of laboratories and organizations working in the four specific areas of concern in preservation--books, paper, adhesives, and mold; (2) directories of indexes, abstracts, and databases which provide information on materials conservation; (3) publications and newsletters concerned with preservation research; and (4) the paper, "Preservation Research at the Library of Congress: Recent Progress and Future Trends" (Chandru J. Shahani). (GL)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

COMMISSION ON PRESERVATION AND ACCESS

REPORT

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☒ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

DIRECTORY

INFORMATION SOURCES ON SCIENTIFIC RESEARCH Related to THE PRESERVATION OF BOOKS, PAPER, AND ADHESIVES

BEST COPY AVAILABLE

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Maxine K. Sitts

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

1785 Massachusetts Avenue, N.W., Suite 313, Washington, D.C. 20036 • (202) 483-7474

The Commission on Preservation and Access was established in 1986 to foster and support collaboration among libraries and allied organizations in order to ensure the preservation of the published and documentary record in all formats and to provide enhanced access to scholarly information.

The Commission is accessible via ALANET (ALA2624) and BITNET (CPA@GWUVM, SITTS@GWUVM), and by FAX (202) 483-6410.

Published by
The Commission on Preservation and Access
1785 Massachusetts Avenue, NW, Suite 313
Washington, DC 20036

March 1990

Additional copies available at no cost
while supplies last.

Reproduction is encouraged.

This publication has been submitted to
the ERIC Clearinghouse on Information Resources
to be made available in both microfiche and hardcopy.

The paper used in this publication meets the minimum requirements of the American National Standard for Information Sciences-Permanence of Paper for Printed Library materials ANSI Z39.48-1984.

TABLE OF CONTENTS

Page Number

Introduction..... 1

Laboratories and Organizations..... 4

Indexes, Abstracts, and Databases..... 10

Publications and Newsletters..... 14

"Preservation Research at the Library of Congress
Recent Progress and Future Trends,"
by Chandru J. Shahani..... 17

DIRECTORY

INFORMATION SOURCES ON SCIENTIFIC RESEARCH RELATED TO THE PRESERVATION OF BOOKS, PAPER, AND ADHESIVES

As preservation administrators generate new approaches to saving the scholarly resources in the nation's academic and cultural institutions, they have called for the development of a directed, shared scientific research agenda. For example, preservation specialists working in library and archives environments have common needs for verified documentation concerning the longevity and fragility of paper, adhesives, and other materials that are used in the production of books and other paper-based collections.

To assist with the formation of a preservation research agenda with a collaborative stance, the Commission on Preservation and Access invited seven preservation specialists to its headquarters on October 30, 1989. [In attendance: Wesley Boomgaarden, Ohio State University; Margaret Byrnes, National Library of Medicine; Kenneth Harris, National Archives and Records Administration; Jan Merrill-Oldham, University of Connecticut; Carolyn Morrow, Harvard University; and Barclay Ogden, University of California, Berkeley. Unable to attend was Gay Walker, Yale University.]

The meeting's informal agenda drew upon a set of correspondence and memos regarding research needs written over the past several years by members of the Policy and Planning Committee of the Preservation of Library Materials Section/Association for Library Collections and Technical Services and the Preservation Administrators Discussion Group of the American Library Association. In the long term, the framework for the day's discussions -- and for the subsequent work to be done -- can be summed up in the following broad questions:

> **How can librarians and archivists most effectively apply the results of scientific research in various disciplines to the specific problems associated with the longevity of paper and other media used to record human knowledge and creativity?**

How can the library and archive communities articulate a workable, useful research agenda for the future that builds upon current research interests and contributes directions for specific applications for preservation needs?

To narrow initial investigations, the group came up with the following common concerns:

* What are the effects of environmental conditions on paper deterioration and aging?

* What are effective methods for mold control and eradication, including dangers from natural disasters, the acquisition of mold-infested collections, and local climatic conditions?

* What are the aging characteristics of polyvinyl acetate adhesives (PVAs) in double-fan adhesive library binding -- how well will newly developed PVAs age within a book, and how will they affect papers and other book components?

Answers to both the broad and specific questions first require a shared awareness of the various information sources reporting on scientific research. Because preservation practice applies knowledge from a wide variety of fields, it is a difficult task to monitor all the basic and applied research underway and to determine which is most relevant for preservation needs. Reports of research -- often conducted in a variety of settings at a number of independently functioning laboratories -- are recorded in a fragmented range of indexes, abstracts, and journals specific to specialized disciplines and not necessarily in library-standard format. It appears that there is not yet any coordinated, consistent dissemination of information about research findings to the library and archive communities.

To begin building a foundation of information sources for the preservation community, the Commission contacted some of the major organizations and laboratories working in the specific areas of concern identified in the October meeting: paper, adhesives, books, and mold. Each of these contacts contributed information specifically geared to the questions above. We hope that this directory will serve as a starting point for the preservation profession as it seeks to:

* increase its knowledge base of basic research in disciplinary fields;

* develop productive search strategies to locate and benefit from relevant research results;

* differentiate between basic research and appropriate applications for library and archives preservation needs; and ultimately,

* articulate specific requirements for applied research and frame research questions in generic terms meaningful to scientists.

-- March 1, 1990
Maxine K. Sitts
Commission on Preservation and Access
Washington, DC

LABORATORIES AND ORGANIZATIONS

American Institute for Conservation of Historic and Artistic Works (AIC), 1400 16th Street NW, Suite 340, Washington, DC 20036; telephone (202) 232-6636. Sarah Rosenberg.

AIC is a non-profit professional membership association that coordinates and advances knowledge and practice in the maintenance and preservation of cultural property. The AIC **Book and Paper Group** (BPG) is composed of conservators working with books, art on paper, and archival materials. Members meet annually to address such issues as paper sizing, exhibition of materials, deacidification, conservation and curatorial relations, and conservation condition surveys.

Canadian Conservation Institute (CCI), 1030 Innes Road., Ottawa, Ontario, Canada K1A 0C8; telephone (613) 998-3721. Charles Gruchy, Director General; Kenneth Macleod, Director, Conservation Research; Raymond Lafontaine, Director, Conservation Services.

CCI is a branch of the Canadian Department of Communications and was established in 1972 to provide conservation treatment, research and training to public museums and galleries in Canada. Although Conservation Services primarily provides treatments, its conservators are involved in some research projects. Conservation Research Services (CRS) includes three divisions: Analytical Research Services (ARS), Environment and Deterioration Research (EDR), and Conservation Processes Research (CPR). CCI publishes biennial reviews of its research projects, a newsletter, notes, and technical bulletins.

CRS presently is conducting research in a number of areas of conservation interest including treatment methods for waterlogged wood-metal composites; the composition of paints used by Canadian native cultures; the volatile emissions from museum display storage and packing materials; adhesives and consolidants used in conservation; analytical methods; and silver polishing. CRS also provides direct analytical, technical, and scientific support to conservation departments in Canadian museums and art galleries.

Although its work is principally directed to museums and art galleries, CCI's research in the area of paper conservation is equally applicable to archives and libraries. Projects in this area include: The Effects of Alkali on the Long-Term Stability of Cellulose; The Development of Methods for the Characterization of Protein Materials for Use in the Evaluation of Conservation Treatments; and The Use of Enzymes in Conservation. One project, An Evaluation of the Effects of Sulphuryl Fluoride (Vikane) On Ligneous and Cellulosic Material, has been carried out as part of a joint study of Vikane with the Getty Conservation Institute and the Conservation Analytical Laboratory of the Smithsonian Institute.

Conservation Analytical Laboratory (CAL) of the Smithsonian Institution, Museum Support Center, 4210 Silver Hill Road, Suitland, MD 20746; telephone (301) 238-3700. Dr. Lambertus van Zelst, Director; Marjorie W. Cleveland, Senior Technical Information Specialist.

CAL engages in research in the conservation and study of museum objects and other materials of historic importance. It also serves as a resource for scientific and technical support to various museums of the Smithsonian as well as to museum professionals at large.

Conservation scientists are engaged in a variety of studies on the composition of materials in historic objects, including paper, and the influences of these compositions on the properties of the materials. They also study the influence of external factors, such as the environment, or certain treatment methods on these properties. Of special importance are studies of the changes in chemical and physical properties with age, and the causes and stabilization of deterioration in museum objects. Research efforts of staff in the conservation treatment department are directed at the development and improvement of conservation treatment technology. Conservators -- all specialists in particular groups of materials and types of objects -- perform actual treatments of Smithsonian collection items. This work, parts of which are often done in cooperation with the scientific staff, leads to general research in treatment methodology.

Examples of research: Long-term investigation of the validity of accelerated aging of paper and other cellulosic materials (reliable acceleration of reactions is essential in order to validate the efficiency and safety of preservation treatments: David Erhardt, research organic chemist). Research on various aspects of treatment through light bleaching and on the effects of a range of aqueous and solvent treatments on the surface texture and strength of paper artifacts. A joint investigation

with the Getty Conservation Institute and the Canadian Conservation Institute deals with the effect of sulphuryl fluoride fumigant on a wide range of materials.

Getty Conservation Institute (GCI), 4503 Glencoe Avenue, Marina del Rey, CA 90292-6537; telephone (213) 822-2299.

GCI Newsletter is distributed free of charge three times a year. GCI furthers scientific knowledge and professional practice in conservation, including needs of fine art collections, historic buildings and sites, and archaeological and ethnographic materials. It has established programs in conservation science, training, and documentation. The Scientific Research Program operates in two locations -- at the Institute headquarters and at the Getty Museum in Malibu, CA. Research is developed in five areas: the museum environment, conservation materials and techniques, new or improved analytical techniques, architectural conservation, and in-situ archaeological conservation. The program includes research undertaken by GCI's own scientific team and research conducted in collaboration with scientists and conservators in the USA and abroad. Priority is given to projects of international concern, to those not previously addressed by other institutions, and to those that complement research conducted elsewhere. The in-house research program investigates materials and products that are used in conservation and explores the applicability of new technologies and analytical methods to conservation practice.

Conservation materials research currently focuses on coatings and consolidants, with the objective of providing information on the physical and chemical properties and aging characteristics of materials commonly used in conservation treatment. Advances or new technologies are studied for their potential application to conservation research and practice. In addition, 20 major conservation research projects have been established in collaboration with institutions in Europe and North America.

Image Permanence Institute (IPI), 50 West Main Street, Rochester, NY 14614; telephone (716) 475-5199. James Reilly. [Although IPI's research is not primarily related to paper, adhesive, and mold, as defined in the introduction, its work on microfilm is directly related to the Brittle Books initiative.]

The IPI at Rochester Institute of Technology is working on four grant-funded projects dealing with photographic and microfilm preservation. Founded in 1985, IPI is a nonprofit academic institute whose main purpose is research in the stability and preservation of imaging materials. The principal sponsor of IPI is the Society for Imaging Science and Technology. Policy for IPI is determined by a Board of Advisors, which includes

photographic manufacturers, museums, federal agencies, archival suppliers, and micropublishers. IPI also offers testing and contract research services on archival products, and participates in committee work on ANSI and ISO standards dealing with permanence of images.

Examples of Research -- Microfilm: With funding from NEH's Office of Preservation, the National Historical Publications and Records Commission (NHPRC), and the New York State Library Preservation Grant Program, IPI has been working for three years to find ways to make microfilm more resistant to Redox blemishes, silver mirroring, and other forms of oxidative attack. The initial success of this research was a new accelerated test method with which to compare and evaluate the effectiveness of protective treatments. Using this test, it was first determined that selenium treatment of microfilm did not provide sufficient protection. After examining a number of other possible treatments, a new approach known as polysulfide treatment proved to be successful in helping film resist even the harshest peroxide atmosphere. New research: As a result of a $485,083 outright and matching grant from NEH, IPI will examine the effects of common air pollutants on all types of microfilm. The project will take three years and will expose film to hydrogen sulfide, nitrogen dioxide, ozone, and sulfur dioxide at controlled temperature and relative humidity. The information gained from the project will help to set maximum pollutant levels for storage areas and determine which gases constitute the biggest threats.

Color Microfilm Research: With funds from the Getty Grant Program under contract from the Commission on Preservation and Access, research is being conducted on the dark stability of commonly used color microfilm products. The study will examine dark stability at various humidity levels and will provide information to the library community that goes well beyond data that the manufacturers provide.

Research on Acetate Safety Film Deterioration: Research funded by NEH, NHPRC, and Eastman Kodak concerns the growing problem with degradation of cellulose acetate safety film bases. The research will investigate the role of storage temperature and humidity in the deterioration process for all of the major types of acetate film. The project involves about 22,000 samples. In addition to chemical and physical tests on the film bases, changes in the gelatin emulsion also are being measured. IPI hopes to learn what conditions trigger deterioration and, conversely, what conditions are needed to guarantee film survival. The data will answer such questions as whether cold storage is necessary or beneficial, and whether reducing the storage relative humidity to 20% from 50% will significantly extend film life.

Library of Congress (LC), Washington, DC 20540. Chandru Shahani, Research Officer, Preservation Research and Testing Office; telephone (202) 707-5634; Henriette Avram, Associate Librarian for Collections Services; telephone (202) 707-6240.

The library's Preservation Research and Testing Office, in concert with other research laboratories and the private sector, engages in research projects designed to improve present preservation techniques and explore new technologies that can be applied to the preservation challenge. Staff scientists provide technical support for LC's preservation and conservation activities and undertake fundamental research to explore the chemical and physical characteristics of information media and mechanisms of deterioration. Basic research also provides the data needed to determine standards in such areas as conservation treatment, environmental control, and preservation supplies.

Descriptions of work in progress, which have not previously been published, are provided in a paper by Chandru Shahani at the end of this listing (see page 17).

Mellon Institute, 4400 Fifth Avenue, Pittsburgh, PA 15213; telephone (412) 268-6854. Paul Whitmore, Director. The Institute conducts research on the chemistry of paper from broad perspectives, including interaction with metals, polymer dispersions, and PVA adhesives.

National Archives and Records Administration (NARA). Washington, DC 20408. Kenneth Harris, Director, Preservation Policy and Services Division; telephone (202) 523-3159; Alan Calmes, Preservation Officer, telephone (202) 523-5496.
By contract with laboratories within the National Institute of Standards and Technology and the National Aeronautics and Space Administration, NARA supports research into the aging characteristics of paper, film, tape, and disk, to determine life expectancies of each and the means to monitor the materials for signs of deterioration and to establish optimal storage conditions for each type of medium. These are ongoing, long-term basic research projects, breaking new ground in chemistry and physics.

NARA's major role is as the keeper of the records of the federal government and as caretaker for the largest accumulation of original documents in the U.S. Materials of interest include handwritten, printed, mimeographed, and hectographed text on paper; printed maps with pencil or pen-and-ink annotations; photographs; original artwork; graphic art; lantern slides and modern black-and-white and color slides; architectural and engineering drawings and blueprints; motion picture film in black and white and color; video recordings; sound recordings on nearly every medium; and machine-readable records.

Examples of in-house research: shrink-wrap study to determine the long-term effect on textblocks of shrink packaging damaged bound volumes in stable plastic; a DEZ test run of mixed archival records by Texas Alkyls in the Summer of 1989; quality control testing of conservation materials and of housing and storage enclosures and development of specifications.

Technical Information Papers due for publication in Spring 1990 include: "National Archives Preservation Research Priorities: Past and Present" (Kenneth Harris, et. al.); "Preservation of Archival Records: Holdings Maintenance at the National Archives" (Mary Lynn Ritzenthaler); "Negative Duplication: Evaluating the Reproduction and Preservation Needs of Collections" (Steve Puglia); "Archival Copies of Thermofax, Verifax, and Other Unstable Records" (Norvell Jones).

UNESCO, Division of the General Information Program, UNESCO, 7, Place de Fontenoy, 75700 Paris, France.

UNESCO publishes papers produced by experts on particular research topics through its General Information Programme and UNISIST. An example: "Prevention and Treatment of Mold in Library Collections with an Emphasis on Tropical Climates: A Records and Archives Management Programme Study," by Mary Wood Lee (June 1988, RAMP PGI-88/WS/9), and "Study on Integrated Pest Management for Libraries and Archives" by Thomas A. Parker (October 1988, RAMP PGI-88/WS/20).

INDEXES, ABSTRACTS, AND DATABASES

Annual Review of Conservation Research Activities (published for five years up until 1987). Canadian Conservation Institute (CCI), 1030 Innes Road., Ottawa, Ontario, Canada K1A 2C8.

Descriptions of all research projects, including purposes, goals, and estimates of likely duration. Includes description of what has been accomplished to date including reports and publications emanating from the project, as well as details about what is intended in the current year. Also includes staff working on specific projects. Examples of research from 1987 edition: Characterization of the behavior and function of lining supports and adhesives; the effects of alkali on the long-term stability of cellulose; the design and use of vacuum suction tables in paintings, paper, and textile conservation; research on effects of relative humidity on paper.

Art and Archaeology Technical Abstracts (AATA), Editorial Office, The Getty Conservation Institute, 4503 Glencoe Avenue, Marina del Rey, CA 90292; telephone (213) 822-2299. Jessica Brown. $30.00 per volume. Volumes 1-7 OP; Volume 8-present (1970-present) available.

Conservation reference publication of abstracts on the technical examination, investigation, analysis, restoration, preservation, and documentation of works of historic and artistic value. Approximately 3,000 abstracts per year. Conservation topics in AATA include environmental control, causes of deterioration, and analysis, treatment, and techniques of paper, books, and archives. From the 1989 edition: "A study of the properties of aged starch paste" (V. Daniels); "Paper complexity and the interpretation of conservation research" (Antoinette Dwan); "An evaluation of ortho-phenyl phenol as a fungicidal fumigant for archives and libraries" (John H. Haines and Stuward A. Kohler); and "Vapor phase consolidation of books with parlene polymers" (Bruce J. Humphrey).

CCI Research Project Review - 1989, (draft). Canadian Conservation Institute (CCI), 1030 Innes Road., Ottawa, Ontario, Canada K1A 2C8.

Sections related to paper conservation include: "An Evaluation of the Effects of Sulphuryl Fluoride (Vikane) on Ligneous and Cellulosic Material," "The Effects of Alkali on the Long-Term Stability of Cellulose," "Development of Methods for the Characterization of Protein Materials (for use in the evaluation of conservation treatments)," and "The Use of Enzymes in Conservation," all by Helen D. Burgess.

International Index of Conservation Research, 1988-first edition. (142 pages, plans for annual publication, $6.00). Contact Cynthia Rockwell, International Center for Study of the Preservation and the Restoration of Cultural Property (ICCROM), Via di San Michele #13, 00153 Rome RM, Italy.

This first edition was published with the knowledge that it was not as complete as would be desirable, but to prevent the collected material from becoming outdated and to encourage a larger response in the future. It is geared for conservators, scientists, archaeologists, and architects in both developing countries and in larger laboratories, museums, conservation centers, and universities. The index does not try to record the "latest" research projects, but rather the general areas in which the professionals listed are working; thus it is a listing of "expertise areas" rather than actual research projects.

Major categories (which are divided into many sub-categories) of particular interest to libraries and archives include: climatology and environmental control, pollution and pollutants, methods of examination/instrumentation, biodeterioration and infestation, archives and library management, photographs, conservation materials; and documentation. The Ford Foundation provided financial support for the project, and the Conservation Analytical Laboratory provided technical support. ICCROM also maintains a mailing list.

Research Abstracts Scientific Program Report, compiled by James R. Druzik, Conservation Scientist, May 1989, 179 pages. Available at no charge from Getty Conservation Institute (GCI), 4503 Glencoe Avenue, Marina del Rey, CA 90292-6537; telephone (213) 822-2299.

Designed to serve as a useful reference aid to the range of scientific activities pursued by the GCI from its inception to the present, this report describes research conducted by the Scientific Program of GCI since 1984, including abstracts of all publications, conference proceedings, and listings of personnel and collaborating institutions. The scientific program is built

around a core program divided into the topics of (1) Museum Environment, which includes libraries and archives, (2) Architectural Conservation, (3) Conservation Materials and Methods, (4) Archaeological Conservation, and (5) New Technologies.

Research examples: "Study of the Effects of Sulfur Dioxide and Nitrogen Dioxide on Deacidified Papers - Parts 1 and 2," "Potential Adverse Effects of Pest Control Agents on the Materials of Museum Objects."

Conservation Information Network (CIN), 4503 Glencoe Avenue, Marina del Rey, CA 90292; telephone (213) 822-2299.

Provides rapid international access to a wide variety of information relevant to conservation research and practice. Online databases provide subscribers with up-to-date information on pertinent technical literature, materials used in conservation treatment, and observations regarding the practical application of these materials. Downloading and an electronic mail system also are available. In addition to direct database access, CIN offers regular printed publications of subsets of the databases and diskette copies of the information that can be used on a local microcomputer. Subscribers also are given information necessary to develop their own databases.

Contributors include: Canadian Conservation Institute (CCI), Conservation Analytical Laboratory of The Smithsonian Institution, The Getty Conservation Institute, International Centre for the Study of the Preservation and the Restoration of Cultural Property (ICCROM), and International Council on Monuments and Sites (ICOMOS). The network is housed on a computer system operated by the Canadian Heritage Information Network (CHIN), which also provides technical support to the project. Development has been guided by the collaboration of the above partners; future direction and database contents will be determined by its users.

Descriptions of databases:

Conservation bibliographic database: Approximately 100,000 citations from the international conservation literature including books, journals, technical reports, and conference proceedings. Coverage extends to any information that relates to the principles or practice of conservation and restoration. Features: all volumes of Art and Archaeology Technical Abstracts, including out-of-print volumes 1 through 7 and as-yet-unpublished references; abstracts of ICCROM's library holdings, currently the largest existing library specific to conservation; compiled bibliographies; previously unavailable material from private sources; and new information gathered by a worldwide network of users and contributors.

Conservation Materials Database: Over 1,000 records of technical information on materials used in conservation that result from objective, quantifiable research; categorization according to safety and optical, chemical, physical, mechanical, and thermal properties; information on materials of potential use to the profession based on their technical properties; records based on practical assessments and observations of materials that have been used in treatments; cross-indexing of references in the bibliographic database.

Product/Supplier Directory: Information on international manufacturers, distributors, and retailers of materials used in conservation.

The Commission requested an exploratory search of the bibliographic database from Marjorie Cleveland, Technical Information Specialist at the Smithsonian Conservation Analytical Laboratory, based on the information needs noted in this paper's introduction. Without any further narrowing of topics or time periods, the search provided 1200 titles on "deterioration and conservation of paper," 437 titles on "lining adhesives," 34 entries on "mold control," 97 entries on "accelerated aging of paper," and 66 titles on "New PVA." Examples: "Accelerated aging of paper: The influence of acidity on the relative contribution of oxygen-independent and oxygen-dependent process" (J.S. Arney, C.L. Novak); "An evaluation of glues for use in paper conservation," (N.S. Baer); "Storage and preservation of books, periodicals and newspapers in tropical climates" (Wilfred J. Plumbe); "The influence of moisture content and temperature on the aging rate of paper," (Adriaan J.J. DePlooy); "New Adhesives for Bookbinding" (J. Miron).

PUBLICATIONS AND NEWSLETTERS

Abbey Publications, 320 E. Center, Provo, Utah 84606, Ellen McCrady. Information-gatherer and provider to the library and archive profession.

Two regular newsletters -- The Abbey Newsletter and Alkaline Paper Advocate --reporting on research, along with other areas of interest. Also maintains internal files on preservation research completed and in process. Also, publication: "Monograph Supplement I - 1989, Artificial Aging as a Predictor of Paper's Future Useful Life," (Helmut Bansa and Hans-H. Hofer), 23 pages, $5.00.

Ageing/Degradation of Paper, A Literature Survey; Report No.1E, from FoU-projektet for papperskonservering, Stockholm. 139 pages, September 1989, ISSN 0284-5636. By Christer Fellers, Tommy Iversen, Tom Lindstrom, Thomas Nilsson, and Mikael Rigdahl.

"FoU-projektet for papperskonservering" is a Swedish R&D project on preservation and conservation conducted by the National Archives, the Royal Library, and the National Land Survey of Sweden, together with other major institutions responsible for the preservation of books and archival material. This literature survey was prepared by the Swedish Pulp and Paper Research Institute (STFI) and the Swedish University of Agricultural Sciences (SLU). Originally published in Swedish in February 1988 as the project's first report, it attracted enough attention in other parts of the world that an English translation was prepared in September 1989. The literary survey summarizes the most important known facts concerning the ageing and degradation of paper. It includes sections on: effects of ageing on the mechanical and optical properties of paper; fold number and folding endurance; chemical reactions during national and accelerated ageing; effects of environment on ageing; physical ageing; microbial decomposition of paper; effect of fibre raw materials, the paper making process and printing; comparison between natural and accelerated ageing of paper; and paper conservation.

American Institute for Conservation of Historic and Artistic Works (AIC), 1400 16th Street NW, Suite 340, Washington, DC 20036.

-- **Book and Paper Annual** (Volumes 1-7, 1982-1988, $30 each for non-members). An anthology of papers from the Book and Paper Group (BPG) pertaining to the conservation and preservation of works on art on paper, books, and library and archival materials, many of which were presented at AIC annual meetings.

-- **Paper Conservation Catalog** (3rd-5th editions, $5-$8.00 each). An NEH grant-supported project by AIC's Book and Paper Group (BPG) outlining treatment procedures and philosophies for the conservation of artifacts and art on paper, drawn from the technical literature and from interviews with practicing conservators.

Both the Annual and the Catalog are reference tools for BPG members, as well as for curators of art museums, historical societies, librarians, archivists, and collectors. Examples of papers: "The Darkening and Bleaching of Paper by Various Wavelengths in the Visible and Ultraviolet" (R.L. Feller, S.B. Lee, and J. Bogaard); "The Analysis of Degradation Products Extracted from Selected 19th Century Papers" (Eugene Cain); "Polyester Encapsulation in Signatures" (Glen Ruzicka); and "Effect on Paper pH and Alkaline Reserve from Magnesium Bicarbonate Introduced via Ultrasonic Humidification" (Bonnie Rose Curtin).

Conservation Science Group Newsletter, available from the Australian Institute for the Conservation of Cultural Material. Contact: The Editor, CSG Newsletter, c/o State Conservation Center of South Australia, 70 Kentore Avenue, Adelaide, S.A. 5000 AUSTRALIA.

First issue published November 1989. Members of the Australian Institute are being asked to supply information on their research, test programs, analytical methods, new problems, new sources of chemicals, and equipment for future issues. Included with the first issue was a list of conservation research projects being undertaken in the U.K. supplied by Peter Winsor, Information Officer of the Conservation Unit of the Museums and Galleries Commission.

Among research projects listed in the November 1989 newsletter: From Sue Bradley, The British Museum: Research on non-aqueous deacidification of paper (various researchers) and an assessment of fumigants (V. Daniels). From C. Velson Horie, Manchester Museum: Controlling heat from lighting and buildup of gaseous pollutants in storage cases. From Ann Moncrieff, The Science Museum: Conservation of linen tracing paper (Barbara Hamman, Institute of Archaeology).

Current Research in Library and Information Science, Including Initiatives and Investigations, a quarterly journal (March, June, August, December) published by The Library Association Publishing Limited, 7 Ridgmount Street, London, England WC1E 7AE; edited by Pirkko Elliott. ISSN 0263-9254. Descriptions of current research projects including the subject of "preservation" which appears under the Technical Processes category.

Library Conservation News, The National Preservation Office, British Library, Great Russell Street, London, England WC1B 3DG.

"A quarterly journal for everyone concerned with conservation." Examples of contents (from October 1989, No.25 issue): Progress on The British Library's support for research into the problem of paper decay and its search for treatments; lists of other publications with conservation research news; listing of upcoming events.

National Archives Preservation Research Priorities: Past and Present. National Archives Technical Information Paper No. 7 by the Staffs of the Preservation Policy and Services Division and the Archival Research and Evaluation Staff. 1990, 15 pages.

Includes sections on history of preservation research at the National Archives; descriptions of the organizational components responsible for preservation research activities; current research priorities including both paper-based and non-paper-based materials; and references. Current research priorities related to paper-based materials include in-house work or the monitoring of research on microenvironments and shrink wrapping, copiers and toners, methods of evaluating materials stability, fumigation, encapsulation, mass deacidification, paper strengthening, and ink and its effect on paper.

Preservation Research at the Library of Congress
Recent Progress and Future Trends

Chandru J. Shahani
Research Officer

Preservation Research and Testing Offfice
Preservation Office

December 19, 1989

Preservation Research at the Library of Congress
Recent Progress and Future Trends

Chandru J. Shahani, Research Officer
Preservation Research and Testing Office

December 19, 1989

Over the past several years, the bulk of R&T's resources were diverted in support of the diethyl zinc (DEZ) mass deacidification program to analyze and test deacidified sample books. Nevertheless, several new research projects in some useful areas of investigation have been undertaken. A few of these projects have been completed, and several are in progress while others await initiation in the near future. The present status of these projects and their progress are described below, along with recent progress in the diethyl zinc mass deacidification program.

1. DEZ Mass Deacidification Project

The following account of progress of the diethyl zinc mass deacidification project has been transcribed directly from an internal memorandum communicated recently by Dr. Peter Sparks:

DEZ Pilot Plant Testing:

The testing program at the Deer Park facility, managed by Sy Friedman, was brought to a close in September of this year. The objectives of this program were accomplished and all data and reports are in the Library. Key accomplishments over the last year were development of engineering data to support the design of the large scale facility, gathering information on optimum performance of the process, gathering information on the treatment of other formats such as large and small maps, large folios and manuscripts in boxes. The latter project proved to be most fruitful and it is clear that boxed manuscripts can be treated easily and effectively. Moreover, there were positive results in the treatment of maps and folios that gave us enough information to be able to work out treatment procedures for these materials in a large scale facility. The contract for experimental work at Texas Alkyls is on its way to being closed. However, some thought should be given to keeping this contract open through the spring because the National Archives has indicated that they may want to do more experiments.

Toxicity of Zinc Oxide:

The toxicity program continues at the Battelle Institute in Columbus, Ohio. The acute exposure studies are complete, the

report written and a final copy should be arriving in October. The sub-chronic study or 90-day exposure study has started on schedule. The exposures should be finished by the end of December and all data analyzed and a report written by June 1990. Dr. Lawrence Fishbein, former Deputy Director of the National Toxicology Program, is our consultant on this project and his contract will remain active so he can continue to assist.

Quality Control:

The quality control project has collected information about how we would like to proceed but the final report must still be written. Dr. Sebera is managing this project.

Work on the mass deacidification procurement package is progressing. Initial information gathering regarding current mass deacidification technologies, characteristics of the Library's collections, and materials handling implications for the Library have been completed. Gerry Garvey is managing the project, and anticipates an RFP in the Spring, 1990.

2. Research on Deacidification of Paper

2.1 Determination of optimal alkaline reserve:

Status: Completed and presented at American Chemical Society's Symposium on "Historic Textile and Paper Materials: Conservation and Characterization - II" in 1988. To be published in 1990 by N. Lindsey, F. H. Hengemihle and C. J. Shahani.

In spite of the extensive literature on deacidification of paper and the recent proliferation of mass deacidification processes, no experimental data have been reported on how much alkaline reserve is needed to obtain the highest gain in stability. In this work, the influence of basic magnesium carbonate on the permanence of paper was studied over a wide concentration range in an effort to determine the optimal alkaline reserve content that should be imbibed into paper in a deacidification process. Test papers were deacidified by immersion in a freon/methanol solution of methyl magnesium carbonate. The alkaline reserve content of the test samples was varied by manipulating the concentration of the treatment solution. The rates of degradation of the test samples have been compared after subjecting them to accelerated aging. The benefit of increasing alkaline reserve reached a limiting point of maximum stability within about 2 percent alkaline reserve for weaker papers. However, stronger papers continued to benefit increasingly with increasing alkaline reserve content, even up to 5 per cent magnesium carbonate, which was the highest alkaline reserve content studied in this work.

2.2 Comparison of aqueous and non-aqueous deacidification processes:

Status: In progress. Scheduled for publication in spring/summer, 1991. by F. H. Hengemihle and C. J. Shahani.

In this work, the relative stabilities of paper samples deacidified in an aqueous magnesium bicarbonate bath, and those treated in a freon/methanol bath of methyl magnesium carbonate have been compared after aging them at 90°C and 50% RH. The samples deacidified by the aqueous treatment age much more slowly, even when impregnated with only a small fraction of the alkaline reserve contained in the samples deacidified from the nonaqueous system. The swelling of the cellulose matrix in water must facilitate the penetration of the deacidification agent.

2.3 Comparison of calcium, magnesium and zinc-based deacidification systems:

2.3.1 Effects on pigment colors:

Status: To be initiated in 1990/91.

As mass deacidification treatments are becoming more accessible and practical, many libraries and archives appear be eager to deacidify their general holdings. However, paper conservators working on individual objects, when faced with a decision whether to deacidify or not, all too frequently choose not to deacidify. Their reluctance to deacidify is due mainly to the fact that the colors and tints of many pigments and inks are sensitive to changes in pH value. Deacidification treatments function essentially by raising the pH value of paper. However, different deacidification systems raise the pH value of paper to a different extent. In this project the colors of selected pigments and inks will be quantitatively measured before and after aqueous deacidification with magnesium, calcium and zinc bicarbonate solutions. Zinc bicarbonate deacidification, which we have successfully applied recently, should lead to the smallest increase in pH, since the final pH of the paper is only about 7 to 7.5. However, deacidification with zinc may also increase the susceptibility of paper to photolytic degradation. It is also possible that color changes produced by magnesium and/or calcium bicarbonate deacidification may be within an acceptable tolerance level.

2.3.2 Resistance to biological attack:

Status: To be initiated in 1990/91.

In general, acidic materials are more resistant to fungal growth than alkaline materials. In deacidifying our collections, do we increase their vulnerability to micro-organisms? Also, do the calcium, magnesium and zinc ions influence the growth of mold

and mildew? Calcium salts generally provide a hospitable environment for biological growth, and some zinc salts have an opposite effect. A comparison of the three major deacidification systems would be most useful.

3. Other Chemical Treatments

3.1 Post-fumigation release of ethylene oxide:

Status: This work was presented at the International Biodeterioration Society's Annual Meeting in 1986 by F. H. Hengemihle, N. Weberg and C. J. Shahani. To be published in 1990.

The carcinogenic nature of this effective but hazardous fumigant is now well established. Federal regulatory bodies have responded by lowering the maximum permissible exposure to a time-weighted average of 1 part per million of ethylene oxide. The exposure of operational personnel during the fumigation process can be controlled by monitoring ethylene oxide concentrations inside and outside the fumigation chamber. A more important concern is the slow release of adsorbed ethylene oxide from treated materials over an extended post-fumigation period. Which materials tend to hold on to ethylene oxide strongly enough to warrant greater caution in their treatment? In an attempt to answer this and other related questions, several library materials were treated with ethylene oxide and their off-gassing rates were measured over an extended post-fumigation period. Photographic materials, wood and newsprint were seen to hold on to ethylene oxide most tenaciously. Off-gassing rates were considerably smaller, although still appreciable, for a pile of randomly selected books and for modern bleached kraft book paper with alum-rosin size. Leather scraps and audio records made of PVC showed only a minimal affinity for ethylene oxide.

3.2 Investigation of the Parylene paper strengthening process:

Status: The preliminary phase of this work was completed and presented at the AIC Annual Conference in 1989 by F. H. Hengemihle and C. J. Shahani. Further work may be initiated in 1990.

While the deacidification process can retard the degradation of paper, it cannot restore lost strength into paper. While some mass deacidification processes can probably incorporate an additional step to strengthen weak paper, none of them has yet demonstrated such a capability. In the meantime, two processes that can indeed strengthen brittle paper, have become a reality. One is a graft copolymerization process developed by the British Library. This is a liquid phase process. The other is the Parylene process, which is a gas phase process developed by the Union Carbide Company, that uniformly deposits a thin coating of a highly stable polymer throughout a book to protect brittle pages.

We have already completed a preliminary study on the Parylene process that suggests it has potential for the library and archive world. We plan to continue our study of the Parylene process to answer several questions which remain, and to compare it with other processes that may become available to us.

4. Environmental Effects

4.1 Effect of contained environments on the stability of paper:

Status: Part I of this study was presented at AIC Annual Conference in May, 1988 by N. Lindsey, F. H. Hengemihle and C. J. Shahani, and will be submitted for publication in JAIC in 1990. Part II of this work is being continued by S. B. Lee and C. J. Shahani, and is scheduled for completion by end of 1990.

Under accelerated aging conditions at a high temperature and high relative humidity (90°C and 50% RH), we have observed that acidic paper ages faster when it is isolated from the environment, as for example, when paper is sealed within a polyester envelope. Even acid paper within a book has been seen to age faster than a single sheet of the same paper that is free to interact with the atmosphere. However, alkaline paper does not age any faster inside an air-tight envelope. The adverse effect of containment on acid paper can be nullified either by deacidifying it, or by inserting a sheet of alkaline paper in contact with it. Encapsulation of paper within polypropylene film was also studied. Its effect on the stability of paper was almost identical to that observed with polyester film encapsulation.

The objective of the work presently in progress is to see if the reaction mechanism by which paper ages within an impermeable envelope observed at 90°C and 50% RH, is similar to the one by which it ages under ambient conditions. In this work, paper samples are being aged at five different temperatures over the range of 45 through 90°C and 50% RH. The shape of the activation energy curve, and a comparison of the activation energy value with that calculated from natural aging of some of the paper samples, should provide valuable insight into the relevance of accelerated aging data obtained earlier. The effect of storage within acid and alkaline box enclosures is also being investigated.

4.2 Effect of cycling relative humidity conditions on the aging of paper:

Status: The first phase of this work by F. H. Hengemihle, N. Weberg and C. J. Shahani was recently published in "Historic Textile and Paper Materials - II," American Chemical Society, Washington, D.C., 1988. The second phase, which will investigate the effects of wider and faster cycles in relative humidity and temperature will be initiated in late 1991 or early 1992.

The effect of fluctuations in relative humidity on the degradation of paper-based materials under accelerated aging conditions was studied to better comprehend environmental needs for long-term storage of paper-based archival materials. The rate of accelerated aging of paper samples subjected to a relative humidity cycling between 40 and 60 per cent at 90°C, was compared with corresponding data for samples aged under constant relative humidity conditions of 40, 50 and 60 per cent at the sample temperature. Test samples were aged as single sheets, as well as within piles which simulated books. Invariably, test papers in piles aged faster than those hung loosely on racks. Also, the adverse impact of cycling relative humidity conditions on the stability of paper was unmistakable. However, the test papers in piles exhibited a greater resistance to changing relative humidity conditions.

4.3 Comparison of rate of change in environmental conditions inside and outside books and manuscript boxes:

Status: This project has just been initiated by F. H. Hengemihle and C. J. Shahani.

Many factors are generally considered in planning for environmental conditions and controls for a new library or archive storage facility. To the best of our knowledge, no consideration has yet been given to the time lag between the actual change in temperature and humidity and the response within a book or a manuscript box. If this response time is long enough, small fluctuations in environmental conditions may not as significant as they are generally perceived to be. Considerable savings can result from requiring less stringent environmental controls. In this work temperature and humidity sensors placed within manuscript boxes and hollowed out books are monitored as environmental conditions fluctuate in a programmed cycle.

4.4 Correlation between environmental conditions and permanence:

Status: This work by Donald K. Sebera has been published in Proceedings of Conservation in Archives, International Symposium, Ottawa, Canada, May 10-12, 1988.

The conservator is often asked to advise on environmental conditions and their expected effect upon the permanence of objects. Also, groups and individuals have proposed various environmental standards for storage, exhibition and shipping of cultural and historic objects. It is difficult to relate environmental conditions to anticipated rates of deterioration and assess the consequences of changing environmental parameters to meet building, climate, cost and other constraints.

This paper describes a simple graphical representation of the relationship of environmental factors to the permanence of hygroscopic materials. The graph can provide the conservator with immediate, quantitative estimates of the effect on permanence of different environmental conditions. Though paper is used as an example, the method is applicable to other hygroscopic materials such as wood, canvas, etc. Using temperature and relative humidity as environmental variables, examples are given of applications to problems of biological attack, annual cycling, cost effectiveness, comparability of proposed standards for storage and identification of areas for research.

4.5 Effect of relative humidity changes on the flexibility of leather and parchment:

Status: This work is in progress and is scheduled for completion by end of 1991. The workers are F. H. Hengemihle, S. B. Lee and C. J. Shahani.

It is generally accepted that lower relative humidity levels are conducive to the longevity of paper-based materials. However, lower levels of relative humidity in libraries and archives can cause irreparable harm to leather bindings and to parchment if they become too dry and inflexible. Besides the danger of physical damage from bending and flexing of such materials in a dry state, excessive dryness can lead to a point of no return, where the lost moisture, and therefore flexibility, cannot be retrieved even upon humidification. Therefore, to be in a position to define optimal environmental conditions for long-term storage of paper, as well as leather and parchment, we need to understand the effects of relative humidity changes upon the flexibility of leather and parchment, and also their moisture-loss and regain characteristics.

5. Effect of Paper Composition on its Stability

5.1 Effect of deacidification agents on papers contaminated with traces of copper species:

Status: This work was presented at Symposium 88 at the Canadian Conservation Institute in 1988 by F. H. Hengemihle and C. J. Shahani. It will be published in the proceedings of that symposium in Spring, 1990.

In work published a few years ago, we established that neutralization of acidic species in paper, even without an alkaline reserve, can retard the degradative effect exerted by trace concentrations of iron and copper contaminants. Recently, this work was extended to study the effect of different deacidification agents on the copper-catalyzed degradation of paper.

In a continuing effort to comprehend the degradative effect of trace concentrations of transition metal contaminants on paper, the effect of some aqueous and non-aqueous deacidification treatments on the accelerated aging of copper-doped paper has been studied. The effects of the Barrow two-step treatment with calcium hydroxide and bicarbonate solutions, and treatments with magnesium bicarbonate, zinc bicarbonate and methyl magnesium carbonate solutions have been compared. Except for the Barrow two-step treatment, all other treatments were applied by an immersion process, as well as by a spray technique. It has been observed that the extent of stabilization of paper against copper-catalyzed degradation depends not only on the nature of the deacidification agent employed, but also the technique by which it is applied. It was established that the beneficial effect of a magnesium bicarbonate treatment was not due to any complex formation between copper and magnesium, as had been suggested by earlier workers. Instead, it was the bicarbonate moiety that was responsible for extracting copper from paper, and thus stabilizing it. Thus, contrary to claims made by some proponents of mass deacidification systems, any deacidification agent which deposits magnesium species in paper would not necessarily stabilize paper against degradative processes catalyzed by copper. On the other hand, almost any aqueous bicarbonate solution can be effective in removing soluble copper species from paper.

5.2 Effect of lignin content on the aging of paper:

Status: This work was initiated a few months ago by S. B. Lee and C. J. Shahani, and is progressing satisfactorily. It is scheduled for completion by end of 1991.

The photolytic degradation of paper due to the presence of lignin, as exemplified by the yellowing of newsprint exposed to sunlight, has been the subject of considerable investigation. However, the effect of lignin on the aging of paper under storage in the dark, is not well established. The immediate significance of this study is that at present, we require that all paper and board that we buy for use in archival storage of library materials be free of lignin. Such materials generally cost twice as much as comparable materials with a very small lignin content. Aside from this economic interest, there are more interesting and fundamental issues that need to be addressed. The chemical structure of lignin suggests that it can act as an anti-oxidant, and therefore exert a stabilizing influence on paper. Can it be possible, therefore, that small concentrations of lignin may contribute to the longevity of paper? Additional reasons for gaining a better comprehension of the effect of lignin on the permanence of paper obtain from the increased use of recycled paper, which may have an appreciable lignin content, and a new trend in paper manufacture, where small amounts of lignin are reintroduced in the paper-making process.

In initial experiments which have just been completed, Sang Lee impregnated test papers with different concentrations of a modified lignin from a dioxane solution. These papers were then subjected to accelerated aging at 90°C and 50% relative humidity, and tested for fold endurance and brightness retention. This first exploratory study suggested that the aging of paper accelerates as its lignin content increases. However, we do not consider this finding conclusive at this stage. This work is being continued with test papers in which pulps with and without lignin content are mixed in different proportions to vary the lignin content. This should be a more definitive study than the earlier phase employing paper samples impregnated with modified lignin. The effect of lignin on alkaline papers will also be investigated.

6. Analysis and Testing of Library Materials

6.1 Comparison of techniques for testing of weak paper:

Status: This work by S. B. Lee and C. J. Shahani is scheduled for completion and publication in 1990.

Research workers investigating the permanence of paper often have a personal preference for tests used to measure the loss in strength of paper as it ages. With different laboratories favoring different testing techniques, it is not easy to compare experimental data, since no one has the resources to employ the full battery of available testing techniques on a routine basis. To resolve this issue, an exhaustive project has been initiated to compare the relative sensitivity of several physical and instrumental tests in the measurement of an incremental loss in the strength of test samples. This work will attempt to bring out the strengths of testing techniques that are best suited to monitor the aging of paper, and weed out those that are not sensitive enough.

6.2 Application of gel permeation chromatographic techniques to analysis of aging in paper:

Status: This work by F. H. Hengemihle and C. J. Shahani is in a preliminary stage, where its feasibility is being studied.

Thus far aged samples of paper have been analyzed mainly by physical testing techniques, since a small chemical change generally results in a much more easily measurable physical change. However, a change in molecular weight measured by viscometric techniques has also been employed to quantify the aging process in paper. The gel permeation chromatographic technique gives a far better insight into degradation of polymers than simple viscosity measurements. In initial experiments we have nitrated the cellulose in paper to solubilize it. These experiments appear promising. But much work is required before we can apply this technique routinely to the testing of aged paper.

6.3 Correlation of thermal analysis of paper with accelerated aging techniques:

Status: This work by F. H. Hengemihle and C. J. Shahani is in a preliminary stage of investigation.

A few workers have tried with a fair degree of success to correlate the rate of accelerated aging of paper to the rate of its weight loss that accompanies a steadily increasing temperature. This work attempts to extend such studies. If a thermal analysis technique can be routinely employed to estimate the stability of a paper sample, it can not only lead to an extensive saving in laboratory time, but also result in better standards for permanent paper than those that are practical today.

6.4 A new accelerated aging technique:

Status: This work by C. J. Shahani is in progress at present, and is scheduled for completion and publication in 1990.

Because of its faster rate, accelerated aging within a polypropylene film enclosure can be used instead of humid aging to save precious time, especially in the quality control testing of paper samples for their stability. It is possible that this accelerated aging technique can be incorporated into a future standard for permanent paper. Present standards for permanent paper rely upon requirements for paper composition rather than upon its aging characteristics.